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Randomised Field Trial of Maintenance Regimes for Optimising Public Transport Depot Efficiency in Senegal

Mamadou Diagne[1]

Department of Mechanical Engineering, Cheikh Anta Diop University (UCAD), Dakar

Correspondence: mdiagne@gmail.com

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ABSTRACT

Public transport maintenance depots in many developing nations face chronic inefficiencies, leading to high vehicle downtime and operational costs. Systematic, evidence-based evaluations of maintenance regimes in these contexts are scarce. This study aimed to quantify the efficiency gains from implementing a structured, data-driven preventive maintenance regime compared to prevailing reactive practices in a West African urban transport setting. A randomised field trial was conducted across multiple depots. Depots were randomly assigned to either a control group (continuing existing practices) or an intervention group implementing a scheduled preventive maintenance system. Efficiency was measured via mean vehicle availability (MVA). The treatment effect was estimated using a linear mixed-effects model: $MVA\{ij\} = beta0 + beta1\,T\{ij\} + uj + \varepsilon\{ij\}$, where $T\{ij\}$ is the treatment indicator for depot j, with uj as depot random effects. The intervention significantly increased mean vehicle availability by 17.3 percentage points (95% CI: 12.1 to 22.5; p<0.001). The reduction in unscheduled corrective maintenance tasks was the primary driver of this improvement. A structured preventive maintenance regime substantially improves depot operational efficiency in this context, demonstrating the viability of randomised trials for infrastructure management research. Transport authorities should adopt scheduled preventive maintenance systems, supported by training and basic data-tracking protocols. Further trials should test scalable implementation models. maintenance optimisation, randomised controlled trial, transport infrastructure, depot management, preventive maintenance, field experiment This paper provides the first application of a randomised field trial methodology to evaluate engineering maintenance systems in African public transport depots, generating robust causal evidence on efficiency interventions.

Keywords: *Randomised controlled trial, Maintenance optimisation, Public transport depots, Sub-Saharan Africa, Fleet management, Operational efficiency, Developing countries*

Article Highlights

- Randomised trial shows 17.3pp increase in vehicle availability from preventive maintenance.
- Reduction in unscheduled corrective tasks was the primary driver of efficiency gains.
- First application of RCT methodology to evaluate engineering maintenance in African depots.
- Supports adoption of scheduled systems with training and data-tracking protocols.

Methodological Note

Treatment effect estimated via linear mixed-effects model with depot random effects, providing robust causal inference in a real-world operational setting.

This trial provides actionable evidence for transport authorities in developing contexts.